Appendix B.

Coarse Filter Analysis for the Fox River Headwaters Ecosystem

Excerpted from a Report Prepared by Clark Forestry, Inc.

Introduction

Clark Forestry, Inc. used a coarse filter screening approach to assess the ecological resources of the FRHE to support landscape-level resource management planning. With that long-term goal in mind, the following report and accompanying Geographic Information System (GIS)-based maps were prepared to achieve the following short-term objectives:

- To gather information on the ecologically important resources of the study area.
- To identify critical habitat.
- To recognize potential restoration and protection opportunities.
- To provide a summary of the above information to participants in the March 2002 Workshop (See Appendix D).

The approach was modeled after the one used to perform a similar assessment of the Wolf River Basin in 1999 (Epstein et al. 2002). The objective was to identify sites with high potential for occurrences of threatened, endangered, and special concern species or natural communities, or sites of otherwise high conservation value. The primary emphasis was identification of potential high-quality natural communities. A related goal of the project was to continue to develop a cost effective, easily replicated process to identify sites using GIS and aerial photography. In order to maintain the efficiency of the coarse filter approach, this analysis was not supported by extensive ground-truthing or field work. We assumed that the methods used in this process would result in missing some small (less than 40 acre) areas and areas whose attributes could not be captured using available data layers.

Information Sources

GIS Data Layers Distributed by WDNR Geographic Services Section (WDNR/GEO):

- County Boundaries, Roads, Highways, Municipalities
- WISCLAND Land Cover Classification
- 75-meter Digital Elevation Model
- Digital Orthophotography
- 1:100K and 1:24K Hydrology
- Original Vegetation Cover
- State Lands
- Surficial Deposits
- Bedrock Type
- Bedrock Depth
- Sections, Subsections, Landtype Associations (from LTA Disk 2.1)
- Ecological Landscapes
- 1:24K USGS DRGs

Data Provided by NHI:

- Element Occurences (point and polygon themes)

- Element Occurence descriptions

Non-Digital Sources:
- 1:15,840 black and white infrared aerial photography
- USGS 1:100,000 topographic maps
- State Natural Area Descriptions
- NHI 2001 Field Inventory Report

Site Types

Finding natural communities - which often occur in very small (< 10 acre) patches on the landscape - can be difficult or impossible using coarse-grained, statewide GIS data layers. Our solution to this problem was to group natural communities into more general "site types" that could be identified on aerial photos based on their gross morphology, and wouldn't fall through a coarse-grained GIS filter. By assessing the list of natural community element occurrences for the study area, looking at existing state natural areas, and consulting those personally familiar with the FRHE, we developed a set of 10 site types that each capture one or more of thee natural communities represented in the study area.

Query Design

GIS queries were designed to identify areas of high likelihood for each site type. The query results provided a manageable area to search more closely with aerial photography and ground truthing.

For each site type we developed search criteria by identifying those attributes that made up a type's "signature," and collecting GIS coverages that contained those attributes. As a starting point for setting the search parameters, we used existing natural community element occurrences, State Natural Areas, and the 2001 NHI Field Inventory report to identify at least one known, representative site for each of the site types. The first query for each type was designed simply to capture the known site. This query, of course, also captured an area outside the known site; we then refined the search parameters based on whether this area was too limiting or too inclusive. Our goal was to capture a manageable area that contained both known and unknown sites. Table B.1 shows a summary of site types, representative communities for each type, search criteria and parameters.

For the mesic forest type, we found that we could not formulate an effective GIS query. We did, however, locate three potential quality mesic forest sites during our aerial photography interpretation phase. For two of the types - open uplands and lakes - we determined that locating potential sites with a reasonable degree of certainty was beyond the scope of this overview. Prairie remnants are impossible to locate using WISCLAND (our finest resolution data layer), and very difficult to identify on black and white infrared aerial photographs because they lack a unique textural or tonal signature. Identifying potential high-quality lakes was also a problem because of the lack of relevant GIS coverages. We believe that input provided by local land managers at the Experts Workshop will fill these gaps effectively.

Table B.1. Coarse Filter Site Types

Site Type	Key Natural Communities	Criteria	Parameters
Kettle Complexes	oak barrens northern dry forest southern dry forest sand barren oak woodland	Wiscland Level 2 Area Surf. Deposits Open Water	175, 190 (deciduous and mixed conifer/deciduous) greater than 100 acres "sand and gravel" Intersect at least one lake smaller than 5 acres
Upland Oak Openings	oak woodland southern dry forest mesic prairie dry prairie	Wiscland Level 3 Area Preset. Veg Surf. Deposits	177 (oak), 179 (northern pin oak), 180 (red oak) greater than 40 acres "oak opening" "clay" and "sand"
Bedrock Controlled Features	bedrock glade dry prairie cedar glade southern dry forest moist cliff	Bedrock Depth Aspect Slope	code 570 (70% of area 5 feet or less to bedrock) southwest (135 to 315 degrees) greater than 5%
Open Uplands	mesic prairie dry prairie	* See Note	
Flatwoods	northern wet forest northern dry mesic forest southern mesic forest floodplain forest	Wiscland Level 2 Area SLOPE	175, 190 (deciduous and mixed conifer/deciduous) greater than 160 acres entire area has slope less than 1%
Mesic Forests	southern mesic forest southern dry-mesic forest northern dry-mesic forest northern wet forest	Non GIS-Based Search	
Open Wetlands	open bog southern sedge meadow shrub carr alder thicket calcareous fen coastal plain marsh emergent aquatic	Wiscland Level 2 Area Or Wiscland Level 2 Area Subsection Or Wiscland Level 2 Area Soil Or Dnr Wetland Class. Area	211 (emergent/wet meadow), 217 (lowland shrub) greater than 640 acres 211 (emergent/wet meadow), 217 (lowland shrub) greater then 20 acres 222Kd or 222Ke (eastern part of basin) 211 (emergent/wet meadow), 217 (lowland shrub) greater then 40 acres "We" or "Wm" (Willette Muck) "shrub/scrub", "emergent/wet meadow" greater than 320 acres
Forested Wetlands	tamarack (rich) swamp floodplain forest northern wet forest	Wiscland Level 2 Area	222 (forested wetland) greater than 100 acres
Streams	stream--cold, hard, fast	Gradient Water Source	greater than 0.3 % groundwater dominated
Lakes		* See Note	

* CFI was unable to formulate effective queries for these site types using available data layers.

Results

After executing GIS queries, evaluating aerial photography, and conducting windshield surveys, CFI identified 48 potential high-quality sites covering almost 92,000 acres within the study area (see Table B.2). The three lowland site types - open wetlands, forested wetlands, and stream corridors - were the most common, and made up 80% of the total acreage. Kettle complexes were the most frequent type on upland sites. Figure B.1 shows their spatial arrangement and Table B.3 provides a complete listing of individual sites and acreages.

Table B.2. Coarse Filter Results by Site Type

Site Type	Number of Sites	Acreage	% of Total Acreage
Open Wetland	17	44,955	48.9%
Forested Wetland	8	6,498	7.1%
Stream	6	22,007	23.9%
Bedrock Controlled Feature	5	1,687	1.8%
Kettle Complex	5	11,335	12.3%
Flat Woods	3	4,400	4.8%
Mesic Forest	3	336	0.4%
Upland Oak Openings	1	729	0.8%
Totals:	48	91,947	100.0%

Table B.3. List of Coarse Filter Sites

Site ID	County	Site Name	Site Type	Acreage
CFI-01	MAR	Limekiln Bluff	Upland oak opening	729
CFI-02	MAR	Oxford Oak Barrens	Kettle complex	4,604
CFI-03	GRE	Puckaway Lake Flatwoods	Flat woods	2,605
CFI-04	ADA	Upper Lawrence Creek	Kettle complex	2,402
CFI-05	WAU	Upper Mecan River	Stream	4,585
CFI-06	MAR	Montello River Floodplain Forest	Forested wetland	1,128
CFI-07	GRE	White River Marsh	Open wetland	23,152
CFI-08	WAU	Chaffee Creek	Stream	4,117
CFI-09	WAU	Wedde Creek	Stream	3,839
CFI-10	MAR	Upper Caves Creek	Stream	3,415
CFI-11	COL	Swan Lake Wetland	Open wetland	2,816
CFI-12	ADA	Upper Neenah Creek	Stream	2,402
CFI-13	WAU	Upper White River	Stream	3,648
CFI-14	COL	French Creek Wetland	Open wetland	2,916
CFI-15	GRE	Grand River Wetland	Open wetland	6,337
CFI-16	MAR	Comstock Bog - Meadow	Open wetland	609
CFI-17	GRE	Berlin Fen And Sedge Meadow	Open wetland	596
CFI-18	MAR	Observatory Hill	Bedrock controlled feature	202
CFI-19	ADA	Jackson Kettle Complex	Kettle complex	780
CFI-20	COL	Weeting Lake Wetland	Forested wetland	1,408
CFI-21	ADA	Adams County National Waterfowl Production Area	Kettle complex	1,324
CFI-22	MAR	Briggsville Conifer Swamp	Forested wetland	226
CFI-23	COL	Red Pine Rock Woods	Bedrock controlled feature	659
CFI-24	MAR	Page Creek Marsh	Open wetland	981
CFI-25	MAR	Little Observatory Hill	Bedrock controlled feature	239
CFI-26	MAR	Stone Hill Swamp	Forested wetland	728
CFI-27	MAR	Tuttle Lake Woods	Flat woods	1,165
CFI-28	GRE	19th Road Marsh	Forested wetland	458
CFI-29	MAR	Mud Lake	Forested wetland	472
CFI-30	GRE	Little Green Lake Mesic Forest	Mesic forest	76
CFI-31	COL	Fox Headwaters Meadow	Open wetland	204
CFI-32	GRE	Grand Lake Wetland	Open wetland	317

Site ID	County	Site Name	Site Type	Acreage
CFI-33	GRE	Manchester Woods	Mesic forest	132
CFI-34	GRE	Marquette Marsh	Open wetland	206
CFI-35	GRE	Roy Creek Forest	Mesic forest	127
CFI-36	GRE	Puchyan River/Snake Creek Bottom	Open wetland	2,193
CFI-37	GRE	Green Lake Station Sedge Meadow	Open wetland	29
CFI-38	ADA	New Haven Woods	Kettle complex	2,225
CFI-39	WIN	Koro Bog	Open wetland	220
CFI-40	GRE	Puchyan Marsh	Open wetland	882
CFI-41	GRE	Mitchells Glen	Bedrock controlled feature	197
CFI-42	GRE	Rock Hill Outcrops	Bedrock controlled feature	390
CFI-43	COL	Lewiston Flatwoods	Flat woods	630
CFI-44	WAU	Jordan's Lake Wetland	Forested wetland	668
CFI-45	MAR	Harris Marsh	Open wetland	1,295
CFI-46	WAU	Upper Mecan River Wetland	Open wetland	1,094
CFI-47	WAU	Upper White River Wetland	Open wetland	1,110
CFI-48	WAU	Wautoma Swamp	Forested wetland	1,410

Assessment of Coarse Filter Analysis

Using GIS and remote sensing data to locate sites of potentially high ecological significance across a landscape is a quickly developing science. Each attempt yields new information about the pitfalls and rewards conducting such an analysis. Early indications show a good correlation between the coarse filter sites and the sites provided by local experts. Though the coarse filter approach was complex, it has advantages when compared to a full-scale inventory of an area. The coarse filter takes a "third party" perspective that results in an objective look at the entire study area. Because it uses a bird's eye view, the analysis allows a quick and cost-effective assessment of the broader landscape context of each site.

However, limitations exist with sites that occur in small patches on the landscape or don't have relatively simple signatures. By definition, GIS queries don't allow one to locate a site smaller than the minimum mapping unit of the input data layers. In this case the finest-grained layer was the WISCLAND land cover grid, with a resolution of 30 meters (about 0.25 acres). The statewide digital elevation model (DEM) is also relatively fine-grained, with a resolution of 75 meters (about 1.5 acres). Most other potentially useful data layers, however, were digitized from statewide maps and are much coarser. For example, the average mapping unit size for the original vegetation coverage is about 2,700 acres, while the surficial deposits average is over 11,000 acres, and the bedrock type average is 21,000 acres. Locating discrete sites that don't have a signature based on the WISCLAND land cover classification, - such as praries, fens, mature forests, or lakes - requires more reliance on aerial photography, local knowledge, and other more traditional information sources.

In the end we were able to conduct a systematic, primarily GIS-based search of the study area for all but three (open uplands, lakes, and mesic forests) of our original site types. A brief description of how we searched for each type follows.

- **Kettle Complexes:** The attributes that make up this type's signature (large forested blocks containing small lakes along the terminal moraine) were relatively easy to capture by searching for the intersections of forests, small lakes, and gravel deposits.

- **Upland Oak Openings:** Because these communities were historically an important component of this landscape, we created a site type that searched for them outside of kettle complexes. As expected, there was a significant amount of overlap between the two types. Though it was impossible to positively identify oak "openings" (because WISCLAND does not provide forest density information), we were confident that the combination of the kettle complex and oak opening queries identify the best oak savanna and/or oak barrens restoration opportunities.

- **Bedrock Controlled Features:** By focusing on southwest facing, steep slopes with bedrock near the surface, we formulated a query that proved very effective after conducting aerial photo analysis and ground truthing.

- **Open Uplands:** This site type was intended to include existing prairie remnants and potential prairie restoration sites. Because LANDSAT imagery doesn't differentiate between old fields or pasture (which represent a significant acreage in the FRHE) and prairies, WISCLAND is of relatively little use. Prairie remnants also often occur in very small patches on the landscape. Color infrared aerial photographs would have been helpful, but the extensive ground-truthing required to effectively locate small prairie remnants would have been beyond the scope of this overview.

- **Flat Woods:** Because it depended on our two highest resolution layers (WISCLAND and the DEM), it was simple to design a query that identified possible sites.

- **Mesic Forests:** Without a layer that provides forest density or age class information, it is difficult to identify high-quality forests using GIS. We did, however, use GIS to identify the general regions most likely to support mesic forests. The most useful information source in this case was aerial photographs, because mature, intact hardwood forests have a unique, easily recognizable signature.

- **Open Wetlands:** Both WISCLAND and the Wisconsin Wetland Inventory provide good information about open wetlands, however provide little information on community quality. A search based on a minimum acreage captures only the large, usually well-documented complexes. In order to capture the smaller wetlands in the eastern part of the project area, we lowered the minimum size to 20 acres and relied more heavily on aerial photo analysis.

- **Forested Wetlands:** Because WISCLAND has a unique category for this type, and potential high-quality sites were likely to occur as large, contiguous tracks, this query was simple and effective.

- **Streams:** Queries for this site type relied on The Nature Conservancy's "Aquatic Classification of Wisconsin's Streams and Rivers Using Physical Characteristics to Predict Biologic Potential" GIS dataset. A simple search of streams with relatively high gradients and groundwater sources effectively captured the higher-quality streams in the area.

- **Lakes:** To date, there is no GIS data layer that provides enough information about Wisconsin's lakes to conduct an assessment of quality. Though the tabular data from the "Surface Water Resources" handbooks for each county have been condensed into a digital database, it is not practical to analyze on a landscape level without spatial attribute information. Lakes are a very important part of the FRHE, but to assess them with any confidence (even at the coarse-filter level) would require resources and expertise that are beyond the scope of this study.

Recommendations for Future Coarse Filter Analyses

GIS-based coarse filter analysis is, and will continue to be, a valuable tool for ecosystem inventory projects. It will become more useful as GIS technology develops and more, higher-resolution layers are made available. Using current statewide layers, GIS queries will capture mostly large, already well-documented sites. As the study size decreases, so does the effectiveness of GIS for locating individual sites. It is important that the scale of the data match the scale of the study area.

At this point, aerial photographs, 1:24,000 topographic maps, interviews with local experts, and ground-truthing are still the best methods for individual site location and characterization. The best use of GIS is to provide a landscape-level overview of a study area, and to quickly determine the ecological context of individual sites.

Future projects will allow us to continue to develop a more systematic method for identifying coarse filter targets. In the next study, it might be more effective to divide the process into two distinct phases, one that focuses on reconnaissance and asks the question "What kinds of unique and/or sensitive ecosystems occur on this landscape?" and a second that asks "Where do these ecosystems occur?"

In the end, there is no substitute for the knowledge held by those who have lived and worked within a study area. But GIS offers the opportunity to efficiently assess the ecological attributes of a large landscape, locate areas where high-quality ecosystems are most likely to occur, and analyze the ecological context that individual sites falls within. The most efficient coarse filter analysis will be the one that incorporates the right balance of local knowledge, published information, and GIS analysis.

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